JACC: CARDIOVASCULAR IMAGING
VOL. 7, NO. 11, 2014

ISSN 1936-878X/$36.00
PUBLISHED BY ELSEVIER INC.
http://dx.doi.org/10.1016/j.jcmg.2014.09.003

EDITORIAL COMMENT

The Dawn of Perfusion CMR

Taking Over From FFR in Suspected Coronary Artery Disease?*

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In this issue of *iJACC,* Li et al. (1) report a systematic review and meta-analysis comparing the performance of perfusion cardiac magnetic resonance (CMR) with fractional flow reserve (FFR) in diagnosing coronary artery disease (CAD).

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Perfusion CMR has an established history. The first studies looking at the role of perfusion CMR in diagnosing CAD were carried out in the 1990s (2). Since then, perfusion CMR has also been used to evaluate coronary stenosis in nonculprit arteries after myocardial infarction (3). Perfusion CMR exploits the fact that under vasodilator stress, maximal coronary blood flow decreases even with a stenosis of >45% (4).

Coronary vasodilation in perfusion CMR is typically induced by adenosine by direct and endothelium-dependent mechanisms, whereas dobutamine, which is used as an alternative, is a β1 and β2 agonist. The perfusion abnormalities that occur are most frequently described in a qualitative fashion (e.g., perfusion defect in the basal anteroseptal segment). Recent work has been done on quantifying perfusion abnormalities; however, additional sequences are needed (5), and a there are a variety of proposed algorithms quantifying the defect observed (6).

Recent studies compared the performance of CMR with that of single-photon emission computed tomography (SPECT) with coronary angiography as the gold standard. CE-MARC (Clinical Evaluation of Magnetic Resonance Imaging in Coronary Heart Disease), a single-center study published in 2012, showed that CMR (a composite of perfusion, cine imaging, late gadolinium enhancement, and magnetic resonance [MR] coronary angiography) had an excellent sensitivity (86.5%), specificity (82.6%), positive predictive value (71.4%), and negative predictive value (79.1%) compared with coronary angiography (7). These associations were not dissimilar when MR coronary angiography was excluded from the analyses. The multicenter MR-IMPACT II (Magnetic Resonance Imaging for Myocardial Perfusion Assessment in Coronary Artery Disease Trial) study showed that the sensitivity of perfusion CMR to detect CAD was superior to that of SPECT, whereas its specificity was inferior to that of SPECT and that CMR was a viable alternative to SPECT in the detection of CAD-related perfusion defects (8).

The EuroCMR registry, a multinational registry collating real-world data from 57 centers in 15 countries has shown the role of CMR in safely evaluating suspected CAD (9), whereas a recent meta-analysis also affirmed the utility of perfusion CMR in determining prognosis (10).

Li et al. (1) have advanced our understanding of the accuracy of perfusion CMR compared with FFR.

FFR is the ratio of maximal achievable blood flow in an artery compared with the theoretical maximal blood flow if the artery was not diseased (11). A value <0.75 is thought to be associated with myocardial ischemia, with Pijls et al. (12) initially deriving this value by comparing FFR values with noninvasive tests of unequivocal ischemia (nuclear perfusion imaging, dobutamine stress echocardiography, or exercise treadmill testing). The use of FFR in clinical practice exploded with the results of the FAME study (Fractional Flow Reserve versus Angiography for Multivessel Evaluation), which showed that FFR-guided percutaneous intervention reduced the rate of death, nonfatal myocardial infarction, and repeat revascularization (composite 1 year endpoint) (13). The routine use of FFR received a further fillip with the publication of the work by De Bruyne et al. (14) (the FAME-2 study),

*Editorials published in *JACC: Cardiovascular Imaging* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Imaging* or the American College of Cardiology.

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which showed that in patients with stable CAD and functionally significant stenosis (as determined by FFR), FFR-guided percutaneous intervention plus medical therapy decreased the need for urgent revascularization compared with best medical therapy alone. It was also shown that in patients without ischemia, best medical therapy provided a more favorable outcome. In this context, comparing perfusion CMR with FFR provides us with valuable additional information. Li et al. (1) show that, with FFR as the reference standard, the pooled sensitivity and specificity of myocardial MR perfusion were, respectively, 0.90 (95% confidence interval [CI]: 0.86 to 0.93) and 0.87 (95% CI: 0.82 to 0.90) at the patient level and 0.89 (95% CI: 0.83 to 0.92) and 0.86 (95% CI: 0.77 to 0.92) at the artery/territory level. They go on to demonstrate that MR perfusion could increase the post-test probability of CAD >80% in patients with a pre-test probability of >37% and could decrease post-test probability of CAD to <20% with a pre-test probability of <72%. This meta-analysis provides further evidence that perfusion CMR should be considered a first-line investigation in suspected CAD (in appropriate patients) and that invasive angiography (to perform an FFR measurement) and its inherent risks and exposure to ionizing radiation can be avoided in carefully selected patients.

Future randomized trials directly comparing perfusion CMR with FFR with hard cardiac endpoints will determine whether there will be a true dawn for perfusion CMR as the investigation of choice in suspected CAD.

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KEY WORDS cardiac perfusion, coronary artery disease, fractional flow reserve, magnetic resonance imaging